

## BIOCHEMICAL FEATURES OF SOME INSECTS SPECIES POTENTIAL PREYS OF PREDATORS

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### ABSTRACT

Mower- net is the technical sampling used on the ground relating to study arthropoda in experimental plots, and in gardens of Agronomic National School El Harrach. Insects category dominates with 1.120 individuals (97.1%) and 55% species (94.7%). Orthoptera are highly mentioned with a number of 856 individuals (74.2%). Gastropoda, Crustacea and Myriapoda, together correspond hardly to 2.9% according to total of captured individuals.

Three techniques of biochemical analyses are used in laboratory with the aim to determine nutritive values and so energetic contribution of some insects species considered as potential preys of different predators. Used methods in the present work are the Kjeldhal method for dose of total nitrogen, Soxhlet method for total lipids and Bertrand method relating to sugars. This analysis shows that proteins rates found in different species vary between 3.5 and 28.4%. For sugars rates found, the weaker is 3.4% while the stronger is 25.5%. For lipids, the recorded contents are about 9.8 and 33.3%. The total energetic contribution brought by the three biochemical components which are, proteins, lipids, and total sugars is estimated at 4.56 Kcal by female of *Aiolopus thalassinus* until 13.77 Kcal by male of *Aiolopus strepens*.

**KEYWORDS:** Plots of Agronomic National School El-Harrach, Nutritive Values of Insects, Energetic Contribution, Kjeldahl, Total Nitrogen, Soxhlet, Totals Lipids, Bertrand Method, Sugars

### INTRODUCTION

Works on the existing links between plants and birds are much more numerous than ones treating of trophic relations between insects and their predators (DOUMANDJI and DOUMANDJI-MITICHE; 1992). But those undertaken in the last quoted field have been supported on analysis of pellets rejection (SOUTTOU et al 2006; DENYS et al 2007; BEN ALAYA and NOUIRA 2007, on analysis of stomach contents of fledglings of *Passer hispaniolensis* (OULD RABAH et al, 2007) and examination of birds droppings (FRETAG 2000, FUENTES et al, 2004 and of *Jynx torquilla* (BENABBAS-SAHKI and, DOUMANDJI, 2010. It exists some general works treating insects biochemistry (CHAUVIN, 1956 WIGGLESWORTH, 1959, RACCAUD-SCHOELLER, 1980).

However, rare are recent works which had treated of this appearance (HAWLITZKY and MAINGUET, 1980, JULLIARD 1984, HANDEL, 1985, HANNA et al, 1986, LEPLAY et al 2000, HARDOUIN and MAHOUX 2003, EKPO and ONIGBINDE, 2007, AKPOSSAN et al 2009; AGIBDYE et al 2009). About research situation on energetic insect's contribution, we have to remind SIEGFRIED's studies (1969), of BELL (1990), of MALAISSE (1997), of ANDE (2003), of F.A.O, (2004), of BOUKHEMZA et al (2006) and of NIABA et al (2011). Concerning works on insects biochemistry in Algeria, there are still less numerous including the one of YAHIA (2009). Trying to complete those studies, we had made

our mind to lean over biochemical composition and on nutritive quality of some 6 Arthropoda species, potential preys of possible predators

## MATERIALS AND METHODS

Insects analysis Is performed with the help to a whole of biochemical methods, in the aim to highlight different nutritive values in proteins, in lipids and in sugars. At the same time, assessment of insects energetic contribution analyzed is then realized. Chosen biological models, make parts of Orthoptera order. Present study is performed in the experimental gardens and in station of the Agronomic National School of El-Harrach (36°43', N; 3° 08' E.). Station situated at 50 m above the sea level. It presents a rain gauge of 541,1 mm in 2005 and 609.1 mm in 2006. It pertains to sub-wet bioclimatic stage with soft winter.

The used sampling technique to capture insects is the mower-net at the rate of once a week. For every species analyzed, rate of dry matter is determined by conventional weight of those species after desiccation into air circulating oven (JARRIGE, 1989), Total nitrogen is measured out by Kjeldhal method. Content in total nitrogenous materials is obtained by the following formula (JARRIGE 1989):  $TNM: \% = N (\%) \times 6.25$ . Raw fat materials correspond to substances removed under ebb by solvent (JARRIGE 1989).

In present study, solvent used is petroleum ether. Sugar proportion is made after defecation and hydrolysis by reduction of alkalino-cupric liqueur and valuation of cooper oxide formed, according cupric-metrical method of Bertrand (LE COQ, 1965). Adopted methods for results operating are making intervention of ecological signs as diversity of Shannon-Weaver and equirepartition and as statistic techniques, analysis of variance and Keuls-Newmann test.

## RESULTS AND DISCUSSIONS

The total number of invertebrates captured in the gardens (ANUS) is 1.153. Most of species pertain to Insect class with centesimal frequency of 97.1%. Others classes are less important as Crustacea (1.8%), Gastropoda (0.9 %) and Myriapoda (0.2%). Concerning Insecta's proportion, the present results confirm those of several authors having employed the same technique of sampling, as SETBEL and DOUMANDJI; (2005) who had mentioned 91.8% and BOUKEROUI et al (2007) noting 81.2%. Among Insecta, order of Orthoptera is the most represented with 856 individuals (74.2 %) followed by those of Coleoptera (12%) and by Hymenoptera (5.3 %).

It is underlined that the relative frequency of Orthoptera captured in the gardens of (ANUS) is much more higher than those pointed out by SETBEL and DOUMANDJI (2005) recording a rate of 29.9% in the same study station and by BENCHIKH et al (2007) mentioning 16.5%. The recorded frequency of Coleoptera during this study (12%) is lower than the one mentioned by SETBEL and DOUMANDJI (2005), which is 33.9 % at (ANUS). Likewise at Cherarba, BENCHIKH et al (2007) mentioning frequency of 23.6 %, whereas BELMADANI et al (2011), in orange grove at TADMAIT reports with a lower rate. Frequency of Hymenoptera of 5.3% is comparable to the one pointed out by SETBEL and DOUMANDJI (2005) 6.8% in garden of ANUS.

In the other hand, CHIKHI et al (2003) at Dergana in medlar tree orchard, and BENCHIKH et al (2007) at Cherarba, in the fallow land, mention higher frequencies of 26.9% at Dergana, and 21.3% at Cherarba. Homoptera are present with rate of 1.7%. This result is comparable to the one found by SETBEL and DOUMANDJI (2005). However, in others environments at Staoueli, DAOUDI et al (2007) recorded 22%, at Blida in a pistachio-tree orchard, BOUKEROUI

et al (2007) report frequency of 13.3%. As for (BELMADANI et al 2011) in orange grove is pointed out 34.1%. Heteroptera order is present with 1.3%. This frequency appears very weak compared the one mentioned by BOUKEROUI et al (2007) with 28.5%. *Diptera* and *Mantoptera* are not much noted (R.A % < 1 %). These values notably for *Diptera* are weak according to 32% pointed out by DAOUDI et al (2007) and 34.1% by BELMADANI et al (2011). Shannon Weaver indication of captured species with the help of mower-net is equal to 4.66 bits. In the same study environment, calculated value by SETBEL and DOUMANDJI (2005) is 5.52 bits, Likewise, BOUKEROUI et al (2007) in pistachio tree at BENI TAMOU pointed out a value of 5.3bits. Equitable sharing of 0.79 shows that present species population seem to be in equilibrium between them.

This value is the same size order that one mentioned by BIGOT and GAUTIER quoted by PONEL (1983) mentioned in riparian zone alongside of Ouvre, equitable sharing of 0.79. Likewise, BOUKEROUI et al (2007) in a orchard near Blida and DAOUDI et al (2007) near STAOUELI, point out values of 0.79. Biochemical composition of insects species analyzed is given in **Table 1**. From this analysis, it results that contents in water of bodies' insects taken in consideration are upper to 50 % and being inferior at 75%.

These results confirm those of several studies realized within the frame of insects nutritive values estimation. In effect, JUILLARD (1984) on 5 insect species analyzed, points out values going from 56.1% for *Gryllotalpa gryllotalpa* at 72.7% for *Gryllus campestris*. A for LEPLEY et al (2000) in South of France, they noted for insect species studied, water contents are between 64 and 67%. From his side, BELL (1990) mentioned contents being 52 and 79 % for several insects species pertaining to different orders.

On the other hand, our results show that contents in water are higher with female than with male, except for specie *Aiolopus thalassinus* where male is richer in water being 72.4%. All authors previously quoted had not studied females and males with a separate manner.. Values in proteins found during this study are comparable to those reported by others authors, on insects pertaining to the same order. So, JUILLARD (1984) pointed out values of 15.3% for *Chorthippus sp* of 19.3% for *Tettigonia viridissima*, of 12.8% for *Gryllus campestris* and 18.3% for *Gryllotalpa gryllotalpa*. Likewise, LEPLEY et al (2000) give rate going from 30.0% for *Calliptamus barbarus* at 23.6% for *Oedipoda coerulescens*, at 23.9% for *Decticus albifrons*, and at 23.9% for *Ducioctaurus maroccanus*. As for. BANJO et al (2006) pointing out 29.6% in proteins for *Analeptes trifasciata* (Coleoptera) and 6.3% for *Brachytrypes spp* (Orthoptera). Nevertheless, our values are lower to those mentioned by AKPOSSAN et al (2009) with caterpillar *Imbrasia oyemensis* (57.8%) and termite *Macrotermes subhyalinus* (38.02%) obtained by NIABA et al (2011). Contents in sugar found tally with those quoted by JUILLARD (1984) for *Tettigonia viridissima* (8.5%), *Gryllotalpa gryllotalpa* (14.5%), *Chorthippus sp* (11%) and *Gryllus campestris* (11%). For LEPLEY et al (2000) the weaker rate equal to 2.6 % is recorded with *Doclostaurus maroccanus*, the higher being of 3.7% for *Decticus albifrons*..Likewise, NAIBA et al (2011), point out value of 3.0% of sugar contained in *Macrotermes subhyalinus* (Isoptera).Lipids rates found during this study,are similar to those reported by AKPOSSAN et al (2009) which point out rate of 23.8% with caterpillar of *Imbrasia oyemensis*. A strong value equal to 31.5% is mentioned by EKPO and ONIGBINDE (2007) for *Macrotermes bellicosus* (Isoptera). Even NAIBA et al (2011) pointed out 46.3% of lipids for *Macrotermes subhyalinus* (Isoptera).

Nevertheless, values pointed out in the present work remain superior than those advanced by JUILLARD (1984) for *Chorthippus sp* (1.8%), for *Gryllus campestris* (1.9%), for *Tettigonia viridissima* (3.8%) and for *Gryllotalpa gryllotalpa* (8.7%). Likewise, LEPLEY et al (2000) record weak values of lipids for *Oedaleus decorus* (1.3%). *Calliptaus*

*barbarous barbarous* (1.3%), *Oedipoda coerulescens coerulescens* (1.8%) *Dociostaurus maroccanus* (2.7%) and *Decticus albifrons* (2.9%). Variance' analysis performed on data corresponding to contents in nitrogenous materials highlight a difference highly significant between the different species studied [ $F_{obs} (24.307) > F_{theo} (380)$ , probability = 0.0001]. Realization of Newman and Keuls test allows gathering averages of *Oedipoda coerulescens sulfurescens*, of *Aiolopus strepens*, of *Acrida turrata* and of *Aiolopus thalassinus*. Comparison test for variable "categories" shows a significant difference between males and females. So, higher values in proteins are pointed out with females by average of 18.9%. As for lipids, variance analysis, test of Newman and Keuls, and comparison test for variable "categories" show absence of significant difference between males and females ( $F_{obs} (0.66) < F_{theo} (4.74)$  with probability of 0.675). As well as for totals sugars, variance' analysis, Newman and Keuls' test and comparison's test do not put in evidence, presence of a significant difference between males and females [ $F_{obs} (2.66) < F_{theo} (4.26)$  with probability of 0.182]. So, all species are making part of the same group. Energetic contribution calculation, with insects analyzed, shows that the higher value in protein contribution is of 1.093 Kcal/g noted with females of *Aiolopus strepens*, even though the weaker contribution is recorded for males of *Acrotylus patruelis* with 0.148 Kcal/g. As for energetic carbohydrate contribution, the higher value is noted for males of *Aiolopus strepens* with 4.604 Kcal/g, when the lower level is pointed out with females of *Aiolopus thalassinus* with 0.672 Kcal/g. As for energetic lipidic contribution, it varies between 8,999 Kcal/g with males of *Aiolopus strepens* and 2,646 Kcal/g for males of *Aiolopus thalassinus*.

However, total energetic contribution brought by the three biochemical components which are, proteins, lipids and totals sugars is higher with males of *Aiolopus strepens* with 13,773 Kcal/g. This result from the last quoted species, allows knowing the higher caloric contribution in diet of potential predators. SIEGFRIED (1969), estimating energetic contribution of Acridiidae mentions a value of 5.61 Kcal/g). According BELL (1990), energetic contribution is variable according orders and families. This last one had pointed out as for order of Orthoptera, value of 22.18 Kj/g (5.30 K/cal). From his side NAIBA et al (2011) mention an energetic value of 581.5 Kcal/100g of dry material for termite *Macrotermes subhyalinus*. Insects would present more important proportion in proteins and in lipids with a strong energetic value than beef and fish (F.A.O., 2004). So, energetic value reported by this institution in 100 grams of dried caterpillars, is about 430 kilocalories.

## CONCLUSIONS

This study puts in evidence nutritional value of some insects species pertaining to order of Orthoptera, knowing that the last ones are contributing greatly in diet of several predators, notably insectivorous. From this analysis, emphasis is placed on superior rates in proteins particularly with females, even though for lipids and sugars differences are not significant between both sexes. Nevertheless, a diet study of those biological models would be necessary to determine preys-species the most frequent or even dominant.

**Table 1: Nutritive Values of Different Insect's Species Analyzed with Consideration of Their Sexes**

| Species                                 | % Proteins | % Sugars | % Lipids | % Dried Materials | % Contents in Water |
|---|------------|----------|----------|-------------------|---------------------|
| male <i>Aiolopus strepens</i>           | 3,97       | 23,02    | 33,33    | 38,99             | 61,01               |
| <i>Aiolopus strepens</i> female         | 25,44      | 13,39    | 13,76    | 32,56             | 67,44               |
| <i>Aiolopus thalassinus</i> male        | 8,78       | 14,23    | 9,80     | 27,59             | 72,41               |
| <i>Aiolopus thalassinus</i> female      | 24,50      | 3,36     | 10,50    | 27,96             | 72,04               |
| <i>Acrida turrita</i> male              | 10,19      | 17,21    | 12,59    | 32,72             | 67,28               |
| <i>Acrida turrita</i> female            | 20,74      | 13,23    | 20,90    | 30,79             | 69,21               |
| <i>Oedipoda coerulescens</i> sulf. male | 8,40       | 12,63    | 14,78    | 35,75             | 64,25               |
| <i>Oedipoda coerulesc.</i> sulf. female | 19,73      | 8,69     | 18,03    | 32,44             | 67,56               |
| <i>Acrotylus patruelis</i> male         | 3,45       | 12,70    | 16,86    | 31,5              | 68,50               |
| <i>Acrotylus patruelis</i> female       | 3,84       | 14,80    | 16,43    | 46,79             | 53,21               |

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